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#1/Declaration

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Andrews et al.

Serial No.: 09/326,925 Group Art Unit: 2813

Filed: June 7, 1999 Examiner: D. Blum

For: LOW COST SHALLOW TRENCH ISOLATION USING NON-CONFORMAL DIELECTRIC MATERIAL

Honorable Assistant Commissioner of Patents
Washington, D.C. 20231

DECLARATION UNDER 37 C.F.R. §1.131

Sir:

Comes now the Declarant, Howard Landis, and states and avers the following:

(1) I am a co-inventor of claims 1-23 of the above-referenced patent application and a co-inventor of the subject matter described and claimed therein.

(2) Prior to June 2, 1999, I had completed my invention as described and claimed in the subject application in the United States. Specifically, prior to June 2, 1999, having earlier conceived of the idea of a process to form planarized shallow trench isolation (STI) structures using a non-conformal high-density plasma (HDP) oxide deposition, including inter alia, providing a semiconductor substrate with raised and lowered regions with substantially vertical and horizontal surfaces, said vertical surfaces having a predetermined height, depositing filler material over the horizontal surfaces to at least a thickness equal to the predetermined height so as to provide raised and lowered regions of filler material, separating adjacent sections of the raised and lowered regions of filler material by at least a gap of exposed underlying material; and selectively removing the raised regions of filler

material, I acted with due diligence to reduce the invention to practice from just before June 2, 1999 to June 7, 1999, the U.S. filing date of the present Application. This is evidenced by the following Exhibits which are attached hereto and incorporated by reference herein (note that any dates deleted from Exhibits A-D are prior to June 2, 1999):

a) Exhibit A is a copy of an invention disclosure which was forwarded to the patent practitioner.

b) Exhibit B is a copy of a letter from me to the patent practitioner, in which I forwarded my comments regarding a draft application to the patent practitioner.

c) Exhibit C is a copy of a letter from the patent practitioner to Shaw-Ning Mei, a co-inventor, in which the patent practitioner forwarded a revised draft of the Application.

d) Exhibit D is a copy of a letter from the patent practitioner, in which a final draft of the Application was forwarded to the co-inventors for signatures.

(3) The above Exhibits clearly demonstrate due diligence from just before June 2, 1999 to June 7, 1999 (the filing date of this Application).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

HOWARD LANDIS

March 19, 2001
DATE

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Title of Invention (Short & Descriptive)
Maskless STI Planarization with HDP Oxide

Disclosure No.	Functional Manager	Receiving Date	Receiving Time
BU898-0158	Brent Anderson		17:35:53

Patent Attorney	Evaluator	Evaluation Area
Jerry Walter	Randy Mann	03

Inventor	Emp.Serial	Div./Dept.	Bldg. or Zip	Location	Tel.Number
Landis, Howard S	522839	29/M63V	972-C	BURLINGTON	446-8329

Area Code	Electronic Address	Manager's Name	Manager's Electronic Address
03	HLANDIS at IBMUSM01	Dennis Bouldin	DBOULDI at IBMUSM01

Table 1. Critical Dates Information	
Date invention workable:	00/00/98
Used or Planned for product:	N
If so, Product Name?	
Release?	
Announce Date?	
Public Demonstration or Use:	N
If so, When?	
Where?	
Disclosed to Non-IBMers:	N
If so, When?	
Where?	
CDA in place?	
Use in Manufacturing:	N
If so, When?	
Where?	
Product Name?	

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Exhibit A

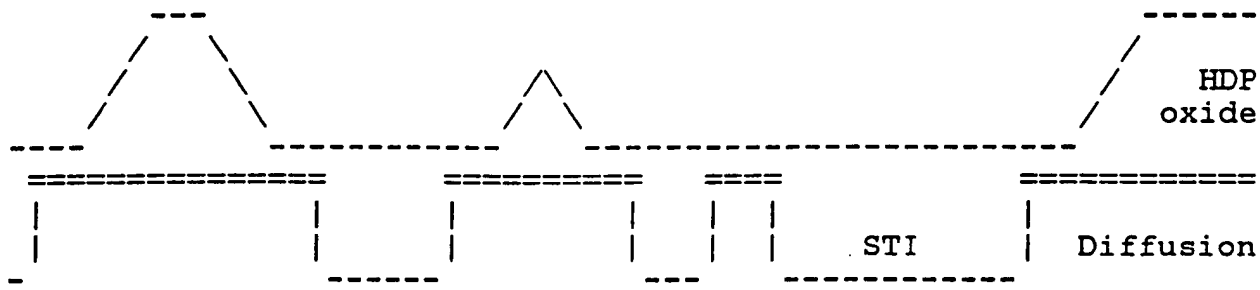
Problem

STI planarization by AB, No-AB, Petri or M-Petri is expensive and can introduce signigicant non-uniformity into the final STI thickness.

Solution

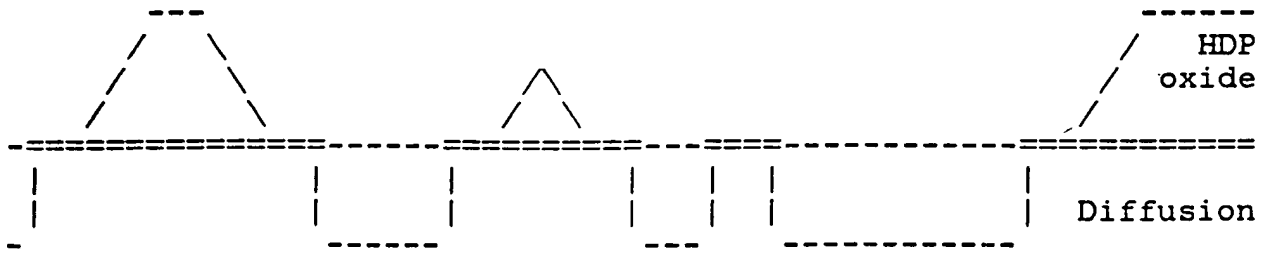
HDP oxide is often used when excellent gap-fill is required. An obvious feature of HDP oxide is the very non-conformal nature of the as-deposited film.

Figure 1. As-desposited HDP oxide



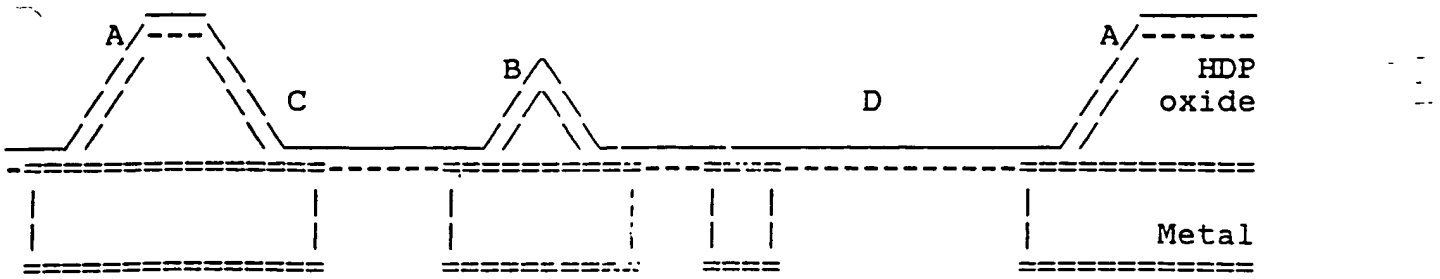
By taking advantage of the reproducibly-small amount of oxide covering the corner of every diffusion, it is possible effect ILD planarization using three short dry-process steps (which can be clustered with HDP oxide dep) and two wet-dips.

Step 1. Isotropic or directional oxide etch

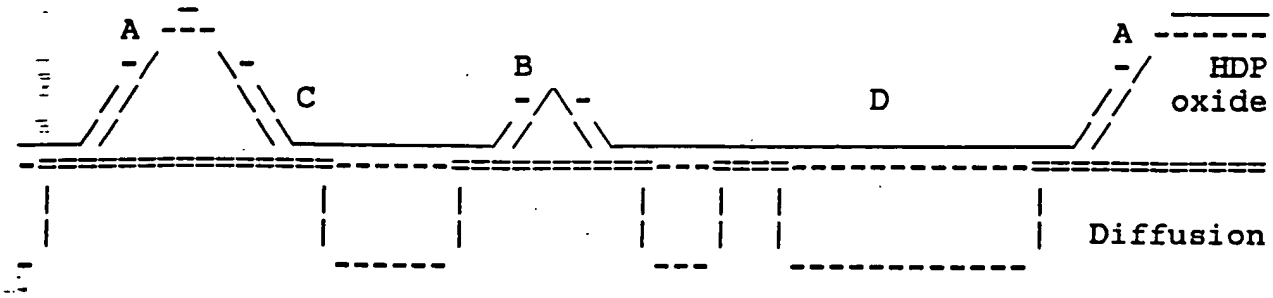


It is important thet the nitride pad gets exposed at the corner of every diffusion. The HDP oxide cannot be anywhere recessed so far that the silicon sidewall is exposed.

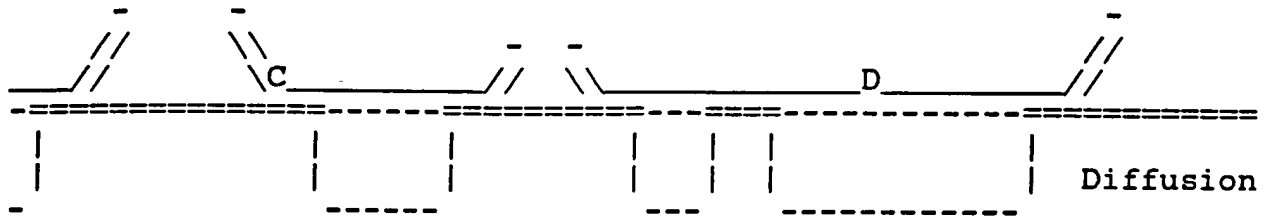
Step 2. Deposit conformal film, such as PECVD silicon nitride



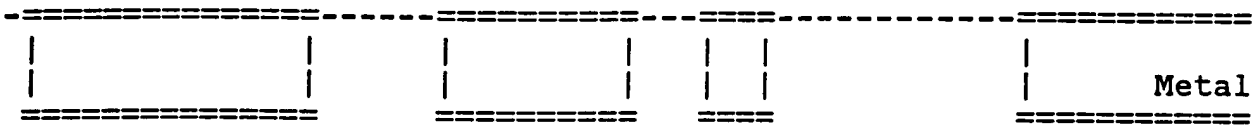
Step 3. Sputter-etch the conformal film, so as to expose HDP oxide at every corner A or B, but to not completely remove the conformal film at any inside-corner C or flat region D.



Step 4. Using an isotropic etch process that is highly selective to the conformal film and to the pad nitride, remove the over-burden of HDP oxide.



Step 5. Using an isotropic etch process that is highly selective to pad oxide and to HDP oxide, remove the remainder of the conformal film.



The wafer is now ready to be re-inserted into the standard process flow for implantration through or removal of the pad oxide.

Generalizations:

1. HDP oxide can be substituted for by any suitable dielectric that exhibits a similar as-deposited topography.

2. The conformal film can be PECVD silicon nitride, or any other film that is suitably conformal, can be sputter-etched as in step 3, is suitably resistant to the isotropic etch in step 4, and can itself be isotropically etched as in step 5.

Potential Concerns:

1. Wide diffusions may be covered by residual conformal film at the end of step 3 These bits of material will be undercut during the isotropic oxide etch in step 4, and will lift off. Detached pieces will be effectively be removed by the isotropic etch in step 5.

2. Very-wide diffusions may be covered by wide-enough sections of residual conformal film so as exceed the distance that the isotropic etch in step 4 can undercut. Such diffusions would need to be identified in each design, and be subjected to a very small amount of "cheesing", as is practiced for damascene copper lines in CMOS-7S0 and CMOS-7SF. For an HF-based wet etch in step 4, the cheese shapes could be made small enough and widely-dispersed enough to have no practical effect on the layout or behavior of the STI.

Evaluation Questions

If this problem has been solved before, how was it solved?

AB, No-AB, Perti and M-Petri are used by IBM for STI planarization.

Why is your solution better?

Potentially much less expensive than all alternatives: no mask, no CMP required.

Who outside of IBM (competitors) would want to use your solution?

Any semiconductor manufacturing company using Shallow Trench Isolation.

How could IBM discover that competitors were using your solution?

I am not sure.

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IBM Microelectronics
1000 River Street
Essex Junction, VT 05452

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hlandis@us.ibm.com

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Wednesday,

David C. Oren
Law Offices of McGinn & Gibb, P.C.
1701 Clarendon Boulevard, Suite 100
Arlington, VA 22209

Re: New U.S. Patent Application
Title: LOW COST SHALLOW TRENCH ISOLATION USING NON-CONFORMAL DIELECTRIC MATERIAL
IBM Docket: BU9-98-0225
Your Ref: BUR.038

Dear Mr. Oren:

Enclosed is a copy of your first draft of the above-referenced patent application, to which I have added some comments and clarification, particularly related to the second embodiment. I have taken the liberty of redrawing a number of the figures, in the hope that they might help you understand the salient features of the invention. I have also added a few figures to better communicate some of the background concepts related to HDP deposition and sputter-etching. I have saved my edits in on the accompanying 3.5" diskette, for your convenience.

Thank you for your diligent efforts in this matter. I look forward to hearing from you soon.

Sincerely yours,

Howard Landis

Howard Landis

Exhibit B

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LAW OFFICES OF
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SEAN M. MCGINN
FREDERICK W. GIBB, III
DAVID C. OREN

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VIA EXPRESS MAIL

Mr. Shaw-Ning Mei
International Business Machines Corporation
Mail Stop MI5
1000 River Street
Essex Junction, VT 05452

Re: New U.S. Patent Application
Title: LOW COST SHALLOW TRENCH ISOLATION USING NON-CONFORMAL DIELECTRIC MATERIAL
IBM Docket: BU9-98-225
Our Ref: BUR.038

Dear Mr. Mei:

Enclosed is a revised draft of the above-referenced patent application which includes all of your suggestions and includes Howard Landis' suggestions. Please review the application and return any written comments to me preferably no later than so that we can finalize the application for filing. Please also ensure that the application is acceptable to your co-inventors, namely, Edward Vishnesky, Bao Hwang and John Andrews. I am separately contacting Mr. Landis for his approval.

Thank you for your cooperation.

Very truly yours,

David C. Oren

DCO/amc
Enclosures

Exhibit C

MAR 18 2002
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EJ692928308US

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SEAN M. MCGINN
FREDERICK W. GIBB, III
DAVID C. OREN

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VIA EXPRESS MAIL

Howard J. Walter, Jr., Esq.
Senior Attorney
International Business Machines Corporation
Intellectual Property Law - Zip 972E
1000 River Street
Essex Junction, VT 05452

Re: New Patent Application
Title: LOW COST SHALLOW TRENCH ISOLATION USING NON-CONFORMAL DIELECTRIC MATERIAL
IBM Docket: BU9-98-225
Our Ref: BUR.038

Dear Jerry:

Having received approval of the application by the inventors, enclosed is the final application and formal papers for the above-identified application. Also enclosed is a diskette with the application saved in WP 5.1/5.2, WP 6/7/8 and ASCII Dos Text, related papers saved in WP 6/7/8 and forms saved in LegalStar.

I have prepared the claims to be consistent with your instructions. Specifically, independent claim 1 corresponds to your sample claim, independent claim 9 is a broad method claim and independent claim 16 is of intermediate scope.

I have also taken this opportunity to enclose our debit note for services and disbursements in connection with the preparation of this application. Thank you for allowing us to be of service to you.

Very truly yours,

David C. Oren

DCO/amc
Enclosures

Exhibit D